

Band offset parameter measured by optical-pumping spectra for high-indium-content InGaN/GaN multiple quantum well structures

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ABSTRACT

Optical pumping in edge-emitting geometry at 25K was applied to study a high-indium-content InGaN/GaN multiple quantum well structure. Several stimulated emission (SE) peaks were observed in optical pumping spectra for the as-grown and the annealed samples. Thermal annealing reduced the inhomogeneity of indium composition resulting to a more effective stimulated emission. The reason for the appearance of the SE peaks was discussed. The intersubband transition of quantized levels was the most probable origination. The transition between quantized levels which corresponds to each SE peaks was precisely calculated by solving Schrödinger equation using the finite-difference method. The band offset parameter (ratio of conduction band discontinuity to valence band discontinuity) which is 38:62 can be obtained. The mole fraction of indium in quantum well was measured by photoluminescence and X-ray diffraction measurement. The results showed that stimulated emission takes place in the high indium phase of quantum well.

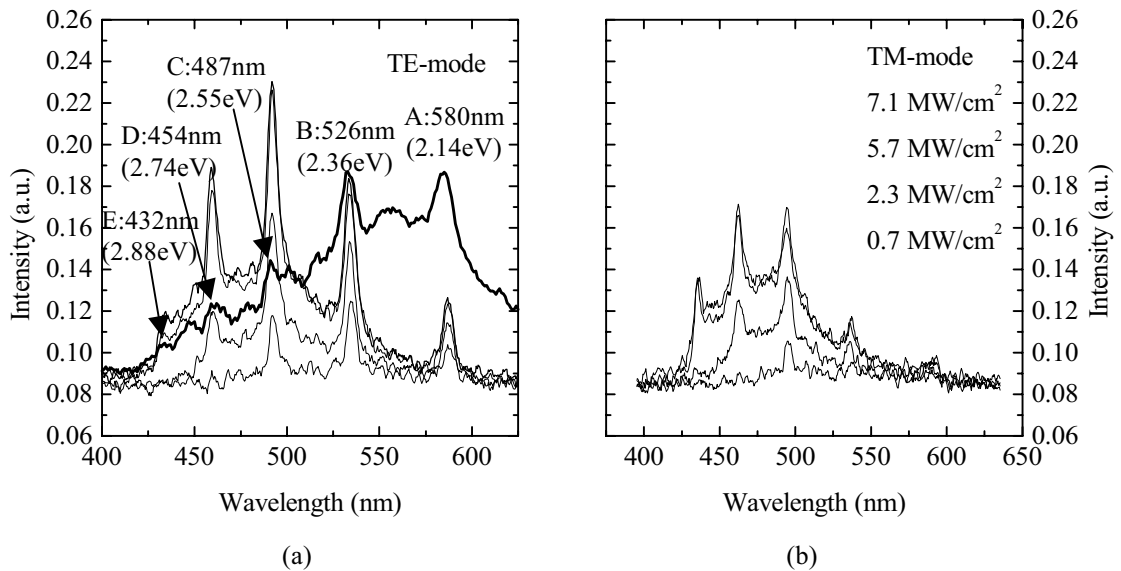


Figure 1 Optical pumping spectra of the as-grown sample (bold line) at 11.4MW/cm² and the annealed sample at 0.7MW/cm²-7.1MW/cm² (a) in the TE mode and (b) in the TM mode at 25K.

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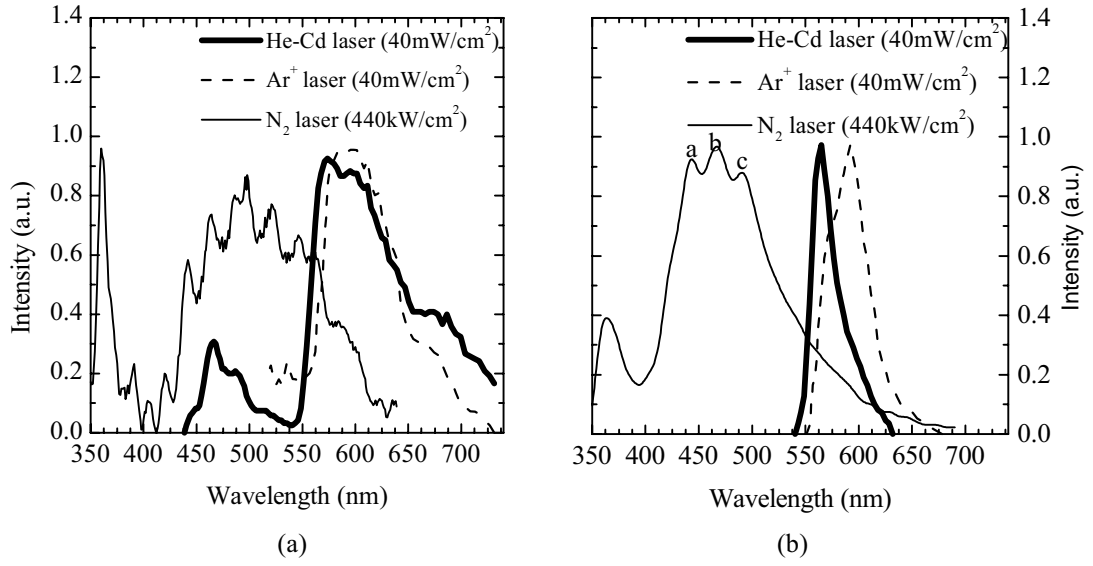


Figure 2 PL Spectra (a) for as-grown samples and (b) for annealed samples excited by N₂ laser, He-Cd laser and Ar⁺ laser at 25K.

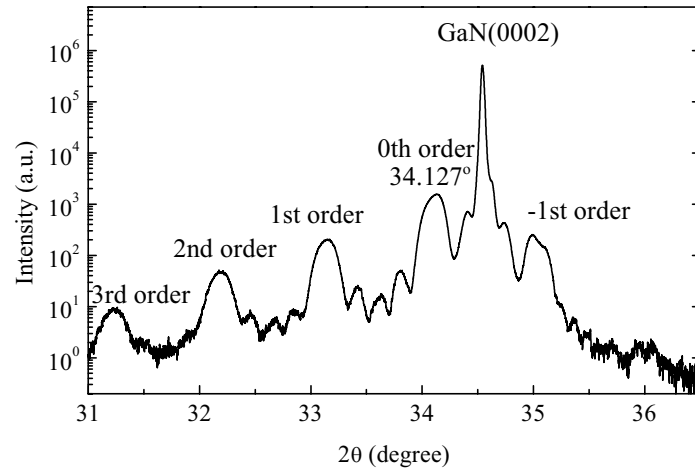


Figure 3 XRD measurement for the as-grown sample and the annealed sample. Two spectra are superimposed.

Interband transition energy $E_{\text{conduction band-valence band}}$	Calculated interband transition energy	Peak position in optical pumping spectra in Fig. 1a
E_{2C-4V}	2.85eV	2.88eV (peak E)
E_{1C-5V}	2.74eV	2.74eV (peak D)
E_{2C-2V}	2.55eV	2.55eV (peak C)
E_{1C-3V}	2.36eV	2.36eV (peak B)
E_{1C-1V}	2.14eV	2.14eV (peak A)

Table 1 Comparison of calculation and optical pumping measurement.